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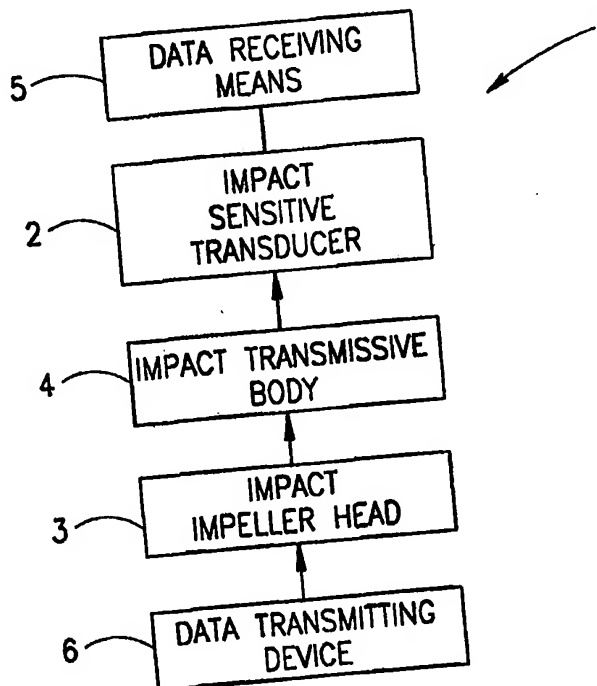
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(54) Title: DATA TRANSMISSION SYSTEM AND COMPONENTS THEREOF

(57) Abstract

A data transmission system (1) suitable for use with an impact transmissive body (4) and including a data transmitting device (6) having a reciprocable impact impeller head (3) for transmitting an encoded series of discrete mechanical impacts to a first surface of the impact transmissive body and a data receiving device (5) having an impact sensitive transducer (2) at a second surface of the impact transmissive body substantially opposite to its first surface for picking up vibrations resultant of the series of impacts.



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Data transmission system and components thereof

FIELD OF THE INVENTION

The invention relates to data transmission systems in general and to impact responsive access control systems in particular.

5 BACKGROUND OF THE INVENTION

In US Patent 4,197,524 to Salem, there is illustrated and described a tap actuated lock for installing on a door's inside surface which is opened when an access combination is tapped on its outside surface. The taps are detected by an impact sensitive device which produces a sensible output in response to an impact.
10 A typical access combination is a four-number code, for example, 4,3,2,5 which requires the tapping of a first set of four taps, a relatively long pause, the tapping of a second set of three taps, a second relatively long pause, the tapping of a third set of two taps, a third relatively long pause and finally the tapping of a fourth and last set
15 of five taps. Such a procedure takes a relatively long time, in fact, anywhere between about 10 to 20 seconds and renders the access combination relatively insecure.

SUMMARY OF THE INVENTION

20 In accordance with the present invention, there is provided a data transmission system suitable for use with an impact transmissive body and comprising:

- (a) a data transmitting device having a reciprocable impact impeller head for transmitting an encoded series of discrete mechanical impacts to a first surface of an impact transmissive body; and
- (b) a data receiving device having an impact sensitive transducer at a second surface of the impact transmissive body substantially opposite to its first surface for picking up vibrations resultant of said series of impacts.

A data transmission system of the present invention is suitable for a wide range of both unidirectional data transmission applications, for example, transmitting readings constituting data from a sensor or a detector to data collection equipment, transmitting control signals constituting data to actuatable components, for example, a solenoid, a motor, a valve and the like and bidirectional data transmission applications. Thus, envisaged applications include, but are not limited to, those in respect of which conventional wired and remote control data transmission systems may be not convenient to install or suitable to operate, for example, transmitting data respectively through and across the walls of a sealed or pressurized container or a reinforced concrete wall.

In a data transmission system of the present invention, data is preferably encoded as the time intervals between consecutive impacts thereby defining an *"average impact baud rate"*, namely, the average number of impacts per second. For example, in the case of a solenoid driven impeller head whose minimum and maximum time intervals between consecutive impacts is 30 msec and 100 msec, respectively, and the minimum time interval increment between consecutive impacts is about 1 msec, there are 70 distinguishable intervals each of which can represent an instruction code, a data reading, and the like. With such a solenoid driven impeller head, the average impact baud rate is about 20 impacts per second, however, it is envisaged an average impact baud rate of a data transmission system of the present invention can be considerably increased.

A data transmission system of the present invention is particularly suitable for implementation in access control applications, for example, to open a mortise lock, to open a bank safe, to obtain entry into a computerized communication and control network e.g. at an automatic teller machine (ATM) and the like. In such applications, a data transmitting device effectively constitutes an

electronically controlled key for typically impacting a single encoded series of impacts, namely, an access combination. In these and other applications, an encoded series of impacts includes, for example, a four interval access combination of 30, 45, 55 and 62 msec which can be transmitted in less than a quarter of a second and is
5 one of a total of 70^4 (i.e. more than 25 million) combinations.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention and to show how the same may be carried out in practice, by way of non-limiting examples, reference will now
10 be made to the accompanying drawings, in which:

Fig. 1 is a schematic block diagram of a data transmission system of the present invention;

Fig. 2 is a pictorial representation of an access control system including an electronic mortise lock and a hand-held, pen-like electronic key;

15 Figs. 3 and 4 are respectively a cross sectional view and a block diagram of the electronic key of Figure 2;

Figs. 5 and 6 are graphical representations of different types of encoded series of discrete mechanical impacts;

20 Figs. 7 and 8 are pictorial representations of the electronic mortise lock of Figure 2 and a data transmitting device respectively activated by a touch keypad and a remote control;

Fig. 9 is a pictorial representation of an electronic combination padlock and the hand-held, pen-like electronic key of Figure 2;

Fig. 10 is a cross sectional view of a data transmitting/receiving device;

25 Fig. 11 is a block diagram of a data transmission system of the present invention for transmitting data from a sensing means to a data collection means;

Fig. 12 is a block diagram of a data transmission system of the present invention for transmitting data from a control means to an actuable component; and

30 Fig. 13 is a block diagram of a data transmission system of the present invention for transmitting data between two data processing systems.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference now to the drawings, Figure 1 shows a data transmission system 1 including an impact sensitive transducer 2 for sensing vibrations resultant of impacts from an impact impeller head 3 transmitted through an impact transmissive body 4 interdisposed therebetween, the impact sensitive transducer 2 being associated with a data receiving device 5 and the impact impeller head 3 being associated with a data transmitting device 6.

Turning now to Figure 2, there is shown an electronic mortise lock 7 including a data receiving device (not shown) coupled to a microphone 8 adapted for intimate juxtaposition against the inside surface of a solid door 9. The door may be opened by a hand-held, pen-like electronic key 10 constituting a data transmitting device.

In operation, the microphone 8 picks up vibrations at the door's inside surface which are the result of the impacts against the door's outside surface from the electronic key 10. The vibrations are suitably processed and then compared to an access combination for selectively operating a motor or solenoid (not shown) to drive a dead bolt 11 between a locking operative position and an unlocking operative position when the encoded series of impacts matches the access combination.

As shown in Figures 3 and 4, the electronic key 10 includes a tubular housing 13 with a closed rear end 13A and an open front end 13B from which extends a tubular leading portion 14A of an electromagnetic device 14, e.g. a push-type solenoid, having a reciprocable pneumatic hammer type impeller head 14B. Interdisposed between the rear end 13A and the push-type solenoid 14 is a battery 15 and a normally open spring biased switch 16 which is closed on depressing the tubular leading portion 14A at key 10 against an impact receiving surface i.e. a door. On closing the switch 16, power is provided to electronic circuitry 17 including a controller 19 for activating the solenoid 14 in accordance with a predetermined code stored in a memory 20.

The key 10 is designed to impact an encoded series of impulse-like, high energy impacts as a function of the presence of absence of impacts at a predetermined impact rate (see Figure 5) or time intervals between consecutive impacts (see Figure 6). For example, Figure 5 shows an access combination

10100101 where 1 is representative of the presence of an impact and 0 is representative of the absence of an impact whilst Figure 6 shows an access combination 59, 31, 49, 51, and 70 msec corresponding to the time intervals between consecutive impacts.

5 Figure 7 shows the electronic mortise lock 7 opened by a data transmitting device 21 including an impact impeller head activated by a touch keypad. Figure 8 shows the electronic mortise lock 7 opened by a data transmitting device 22 including an impact impeller device activated by remote control. Figure 9 shows an electronic combination padlock 23 opened by the electronic key 10.

10 For use in bidirectional data transmitting systems, Figure 10 shows a data transmitting/receiving device 25 including a push-type solenoid 14 and a microphone 8, the former having a reciprocable impeller head 14B for indirectly impacting against an impact transmissive body 26 via an interior wall 27 of the device.

15 Figure 11 shows a data transmission system 28 for transmitting data from a sensing means 29 to a data collection means 31 via an impact impeller device 3 and an impact sensitive transducer 2 disposed on opposite sides of an impact transmissive body 30.

20 Figure 12 shows a block diagram of a data transmission system 33 for transmitting data from a control means 34 to an actuable component 36 via an impact impeller device 3 and an impact sensitive transducer 2 disposed on opposite sides of an impact transmissive body 35.

25 Figure 13 shows a data transmission system 37 for transmitting data between a pair of data processing systems "A" and "B" 38 and 39 via a pair of transmitting/receiving devices 25 disposed on opposite sides of an impact transmissive body 40.

30 While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made. For example, instead of a microphone, an impact sensitive transducer can be implemented by a piezoelectric device, and the like. Data transmission can be encrypted in accordance with conventional data

encryption standards. In addition, for example, in control access applications where access combinations are necessarily matching, they can be periodically updated using conventional algorithm based combination generators hitherto incorporated in vehicle security systems, burglar systems and the like.

CLAIMS:

1. A data transmission system suitable for use with an impact transmissive body and comprising:
 - 5 (a) a data transmitting device having a reciprocable impact impeller head for transmitting an encoded series of discrete mechanical impacts to a first surface of an impact transmissive body; and
 - (b) a data receiving device having an impact sensitive transducer at a second surface of the impact transmissive body substantially opposite to its first
10 surface for picking up vibrations resultant of said series of impacts.
2. The system according to claim 1 wherein a series of impacts is encoded as a function of the time intervals between consecutive impacts.
- 15 3. The system according to claim 1 wherein a series of impacts is encoded as a function of the presence or absence of impacts at a predetermined impact rate.
4. A data transmitting device for use in a system according to claim 1.
- 20 5. The device according to claim 4 configured to be hand-held.
6. The device according to claim 5 activated on its being pressed against an impact transmissive body.
- 25 7. The device according to claim 4 activated by an integrally formed user interface.
8. The device according to claim 4 activated by a remote control user interface.
- 30 9. A data receiving device for use in a system according to claim 1 and responsive to an average impact baud rate of greater than 20 impacts per second.

10. A data transmitting/receiving device for use in a system according to claim 1 and including an impact impeller head and an impact sensitive transducer.
- 5 11. The device according to claim 10 wherein said impact impeller head indirectly impacts against an impact transmissive body.
12. A lock and a key in combination according to claim 1.
- 10 13. A key for use in a system according to claim 12.
14. The key according to claim 13 configured to be hand-held.
- 15 15. The key according to claim 14 activated on its being pressed against an impact transmissive body.
16. A lock for use in a system according to claim 1 and responsive to an average impact baud rate of greater than 20 impacts per second.
- 20 17. A system according to claim 1 for transmitting data from sensing means to data collection means.
18. A system according to claim 1 for transmitting data from control means to an actuatable component.
- 25 19. A system according to claim 1 for transmitting data between two or more data processing systems.

AMENDED CLAIMS

[received by the International Bureau on 29 July 1998 (29.07.98);
original claims 1-19 repaced by amended claims 1-25 (3 pages)]

CLAIMS:

1. A system for data transmission through an impact transmissive body and comprising:
 - (a) a data transmitting device having a reciprocal impact impeller head for transmitting an encoded series of impulse-like mechanical impacts to the impact transmissive body; and
 - (b) a data receiving device having an impact sensitive transducer for picking up vibrations resultant of said series of impacts from the impact transmissive body.
2. The system according to claim 1 wherein a series of impacts is encoded as a function of the time intervals between consecutive impacts.
3. The system according to claim 1 wherein a series of impacts is encoded as a function of the presence or absence of impacts at a predetermined impact rate.
4. The system according to any one of claims 1-3 wherein said data receiving device is responsive to an average impact baud rate of greater than 20 impacts per second.
5. The system according to any one of claims 1-4 for transmitting data from sensing means constituting said data transmitting device to data collection means constituting said data receiving device.
6. The system according to any one of claims 1-4 for transmitting data from control means constituting said data transmitting device to an actuatable component constituting said data receiving device.
7. The system according to claim 6 wherein a lock opening device constitutes said control means and a lock constitutes said actuatable component.

8. The system according to any one of claims 1-4 for transmitting data between two or more data processing systems.
9. A data transmitting device for use in a system according to any one of claims 1-7.
10. The device according to claim 9 configured to be hand-held.
11. The device according to Claim 10 activated on its being pressed against an impact transmissive body.
12. The device according to claim 9 activated by an integrally formed user interface.
13. The device according to claim 9 activated by a remote control user interface.
14. The device according to any one of claims 9-13 constituting a lock opening device for opening a lock.
15. A data receiving device for use in a system according to any one of claims 1-7 and responsive to an average impact baud rate of greater than 20 impacts per second.
16. A data transmitting/receiving device for use in a system according to claim 8 and including an impact impeller head and an impact sensitive transducer responsive to an average impact baud rate of greater than 20 impacts per second.
17. The device according to claim 16 wherein said impact impeller head indirectly impacts against an impact transmissive body.

18. A method for data transmission through an impact transmissive body and comprising the steps of:
- (a) transmitting an encoded series of impulse-like mechanical impacts to the impact transmissive body; and
 - (b) picking up vibrations resultant of the series of impacts from the impact transmissive body.
19. The method according to claim 18 wherein a series of impacts is encoded as a function of the time intervals between consecutive impacts.
20. The method according to claim 18 wherein a series of impacts is encoded as a function of the presence or absence of impacts at a predetermined impact rate.
21. The method according to any one of claims 18-20 the series of impacts is transmitted at an average impact baud rate of greater than 20 impacts per second.
22. The method according to any one of claims 18-21 for transmitting data from sensing means to data collection means.
23. The method according to any one of claims 18-21 for transmitting data from control means to an actuatable component.
24. The method according to claim 23 for opening a lock.
25. The method according to any one of claims 18-21 for transmitting data between two or more data processing systems.

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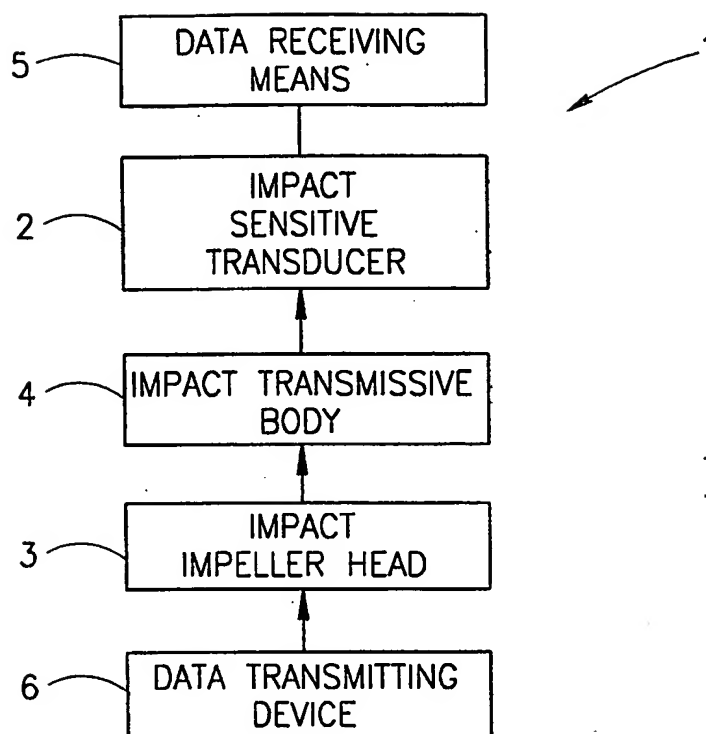
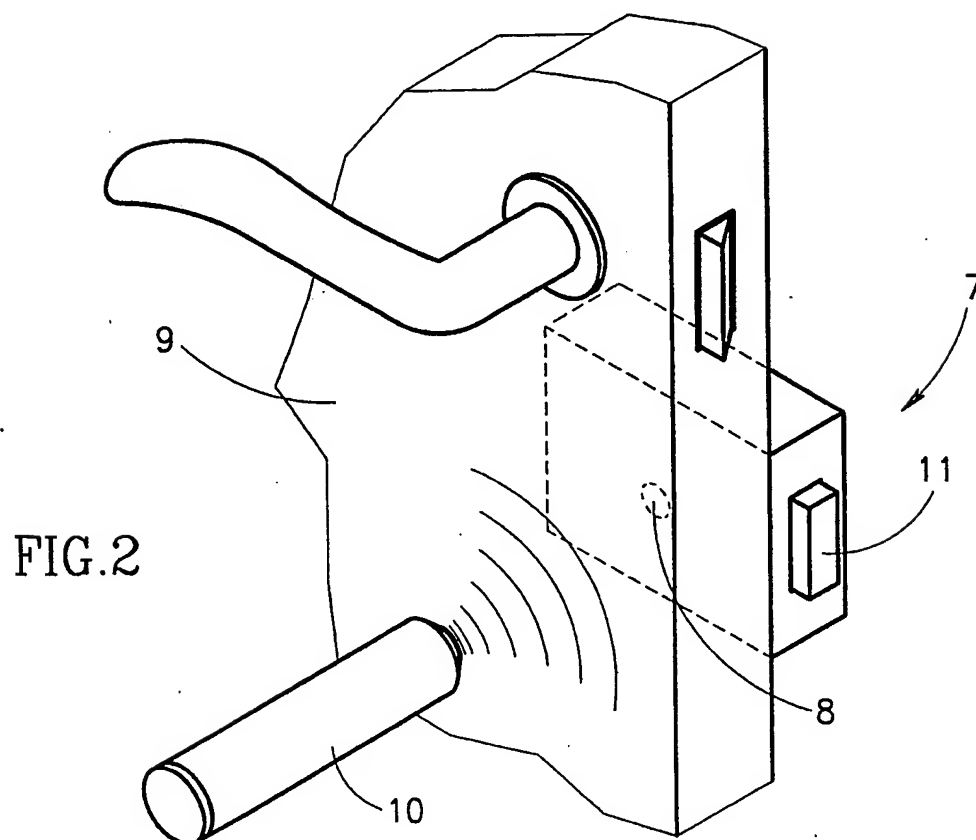


FIG.1



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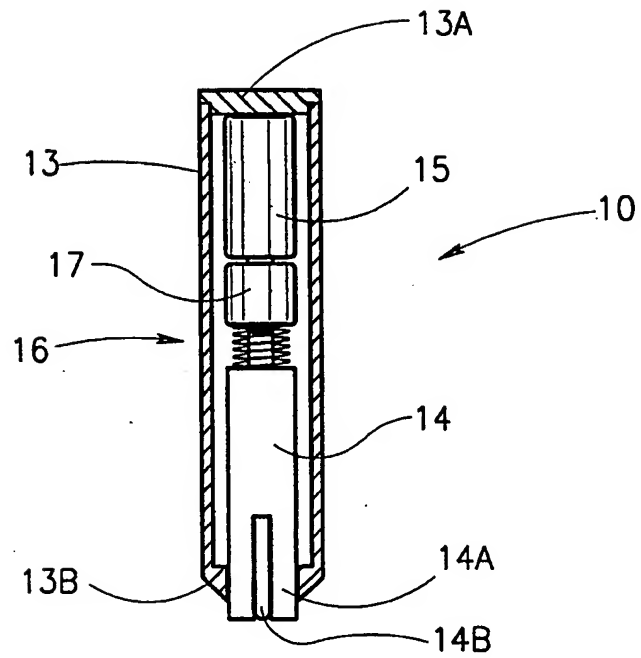


FIG. 3

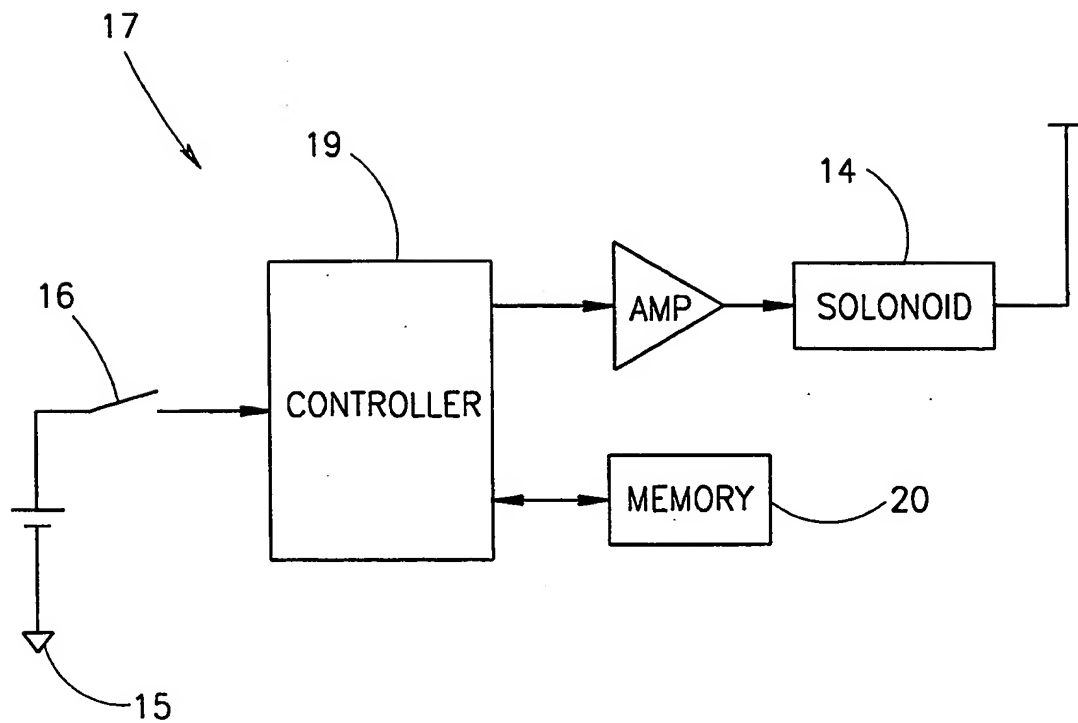


FIG. 4

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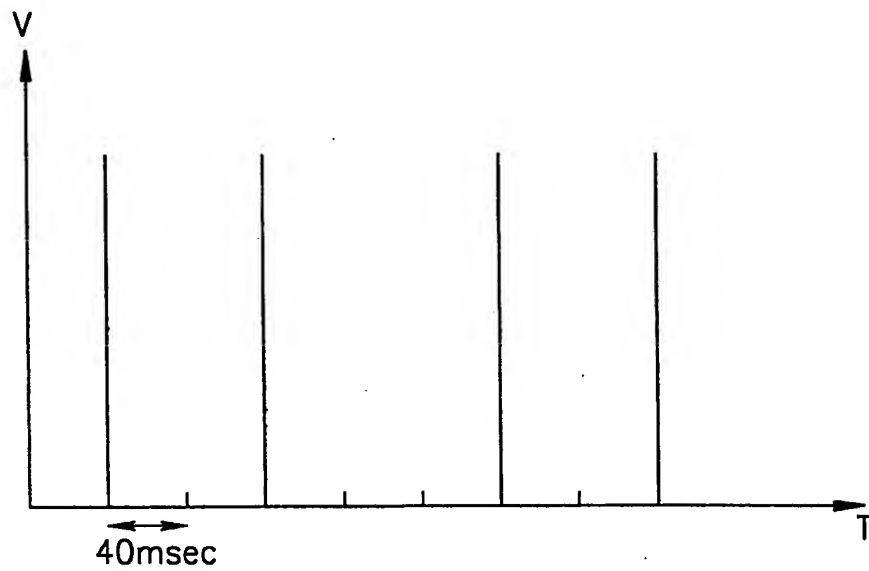


FIG. 5

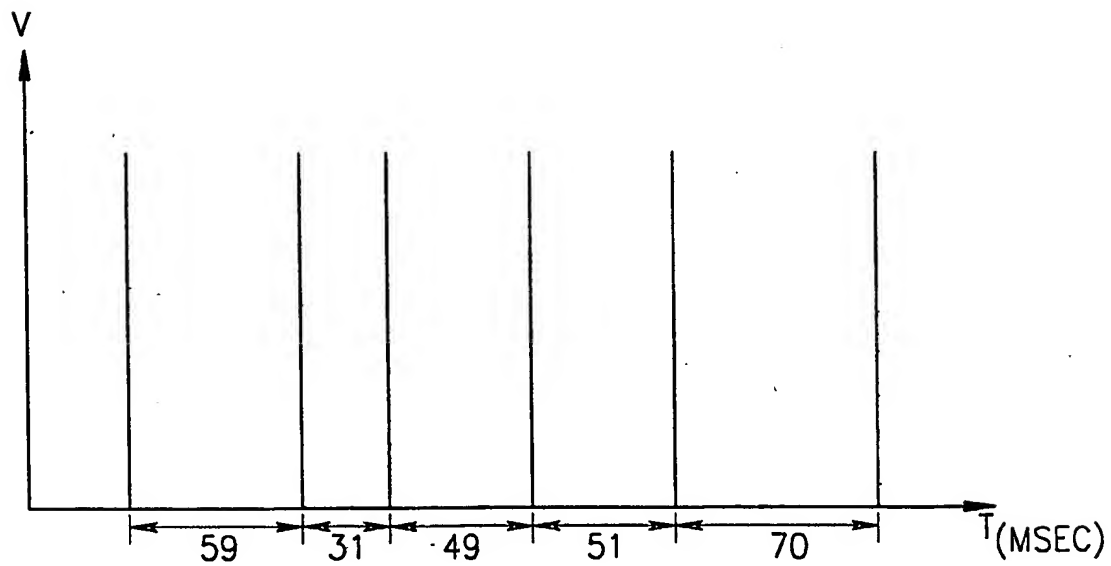


FIG. 6

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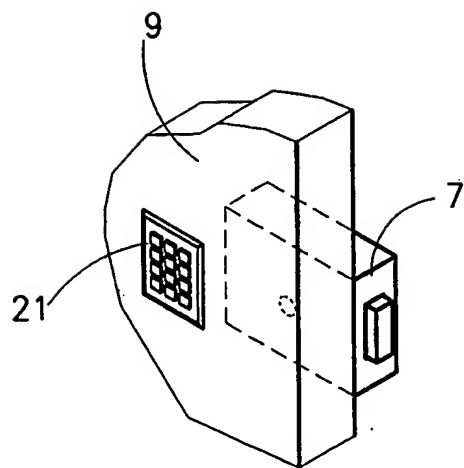


FIG. 7

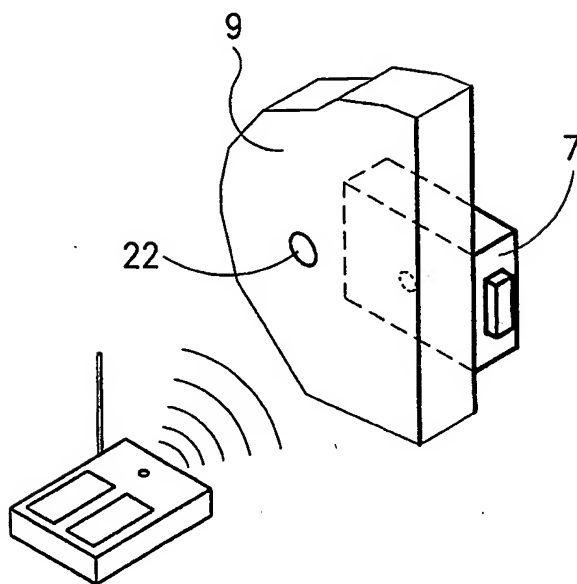


FIG. 8

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FIG. 9

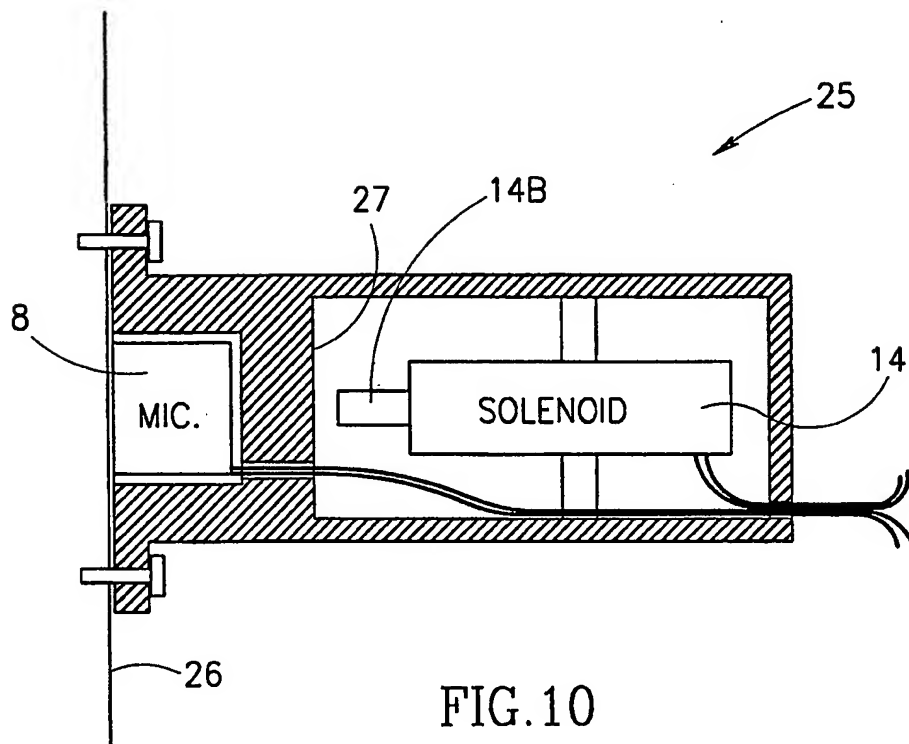
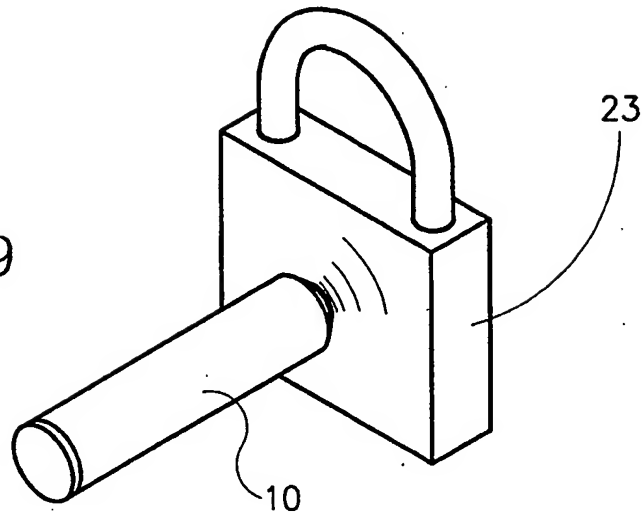


FIG. 10

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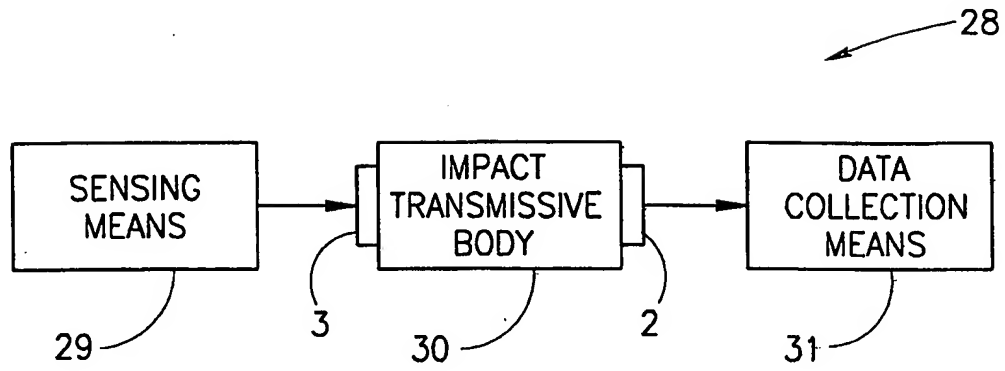


FIG.11

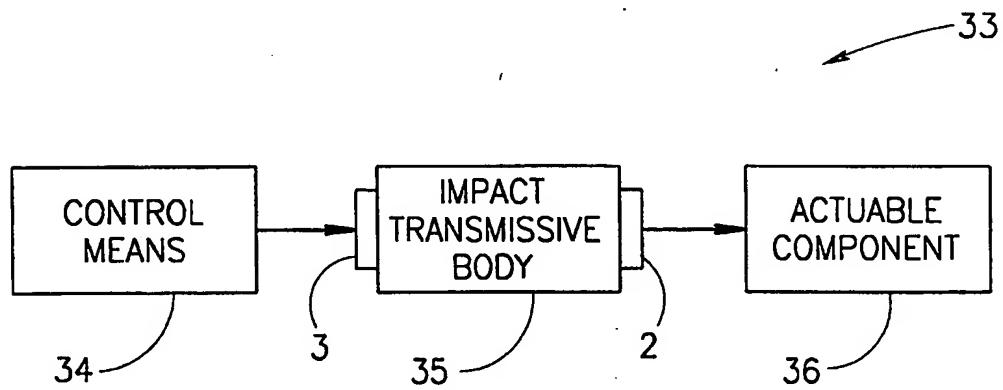


FIG.12

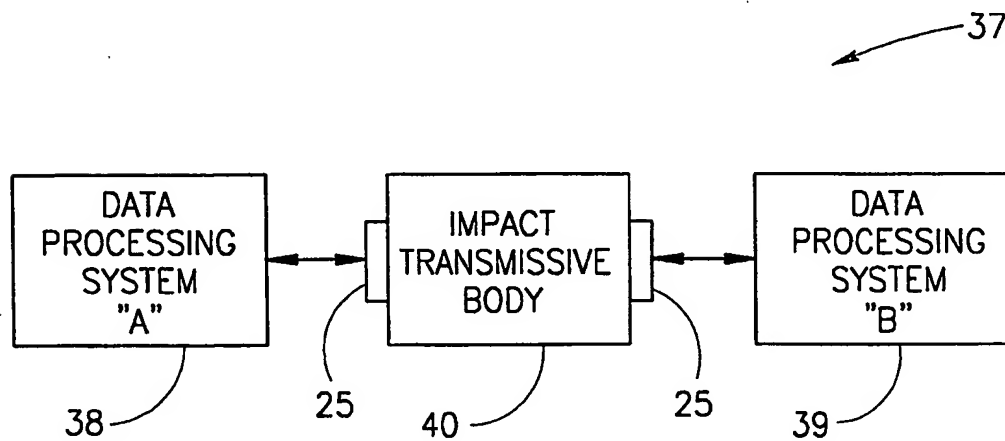


FIG.13

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 98/00105

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E05B49/00

According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 261 768 A (REIFEL) 30 March 1988 see column 5, line 18 - column 6, line 55; figure 4 ---	1,4,10, 11,17
A	US 4 780 856 A (BECQUEY) 25 October 1988 see column 4, line 10 - column 6, line 50; figures 1-14 ---	1,2,4,8, 9,17
A	US 4 197 524 A (SALEM) 8 April 1980 cited in the application see column 3, line 48 - column 5, line 43; figures 1-3 --- -/--	1,2,4-7, 10, 12-15, 17,18

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☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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P, X A	DE 196 15 932 C (SCHUMACHER, KEMMANN) 18 September 1997 see column 5, line 14 - line 45; figures 3,4 -----	1, 2, 4, 6, 7, 10 12-14, 17, 18

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Information on patent family members

International Application No

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